



Plant assemblages within and adjacent to Protected areas of Adina Deer Park (Forest), Malda, West Bengal, India

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ABSTRACT

Adina Deer Park is one of the famous protected ecological zone which was granted as mini zoo through the conditional recognition by Central Zoo Authority of India. In association with faunal conservation this forested land has rich floral diversity. As a manmade or semi-natural forest Adina Deer Park is recommended for many timber species. Beside timber producing plants, on timber forest produce (NTFP) plants are also important for the enrichment of this ecosystem and wildlife. To maintain the stability of forest and its component, it is necessary to protect all plants from local extinction. For implementation of conservation policy of such plants especially non timber plants baseline documentation is very much needed. In addition to ecological importance, forests are significant repositories of bio-resources like food, fodder, fuel, medicine etc., which are utilized by native people of forest fringe areas. Plant communities play many vital roles in forest ecosystems and their diversity is frequently used to assess the biological condition of habitat of any ecosystem. Hence, the present study was aimed at documenting the plant species in Adina Deer Park. The purpose of this study was also to explore ethno-botanical information of the plants along with the status of local threat on the plant. A total of 178 plants from 59 families were identified from the forest patches of Adina Deer Park.

Keywords: Adina Deer Park, Adina Forest, Malda, Biodiversity, Ecopark, Ethnobotany, Conservation.

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INTRODUCTION

In present era world has facing many deleterious environmental problems due to natural factors and anthropogenic disturbances. Loss of forested area and degradation of biodiversity are the most alarming environmental issues which impart many challenges to the human life as well as to the existence of earth ecosystem. During the course of early civilization forests cover accounts almost half of the earth's surface but presently it is reduced into less than one third of total areas [1]. Biodiversity has recently emerged as an issue of both scientific and political concern primarily because of an increase in extinction rates caused by human activities [2]. The importance of biodiversity has been well recognized in the recent decades and many countries would argue that biodiversity is essential for allowing sustainable development of various human activities. Biodiversity management includes protection of existing nature flora and fauna, re-vegetation on deforested land, re-introduction of locally extinct plants and animals and introduction of suitable plant and animal species. Governments and other bodies around the world have currently pledged to grow trees in deforested areas and it is increasingly recognized as an effective way to restore the forested land as well as to soak up the world's carbon emissions. Forests are the repositories of natural wealth that support the ecological balance of the earth by providing essential services including nutrient cycling, air and water purification, drought mitigation and soil recuperation [3]. In India government had been decided to establish many managed biodiversity regions like ecopark, ecovillage etc to enhance ecotourism and protection of biodiversity. Adina Deer Park or Adina Forest is one of the important examples of ecotourism places which also facilitate conservation of biodiversity within the park and adjacent area under the forest beat.

Adina Deer Park or Adina Forest is one of the famous man-made forest of India which was initiated as a miniature zoo for awareness building for animals and conservation of biodiversity. It provide a glimpse of wild animals to the general public for developing a healthy relationship between the animals and human

beings and to promote conservation of our invaluable faunal resources through display, care and awareness [4]. Though it is famous for Deer (*Axis axis*) and Nilgai (*Boselaphus tragocamelus*) but the area has now become habitat of many animals like turtle, water snake and residential and local migratory birds, small mammals, reptiles, amphibians, snails, butterflies and insects. Like other small patches, such small forested areas of Adina Deer Park can make an important contribution to biodiversity conservation as these patches will often have substantial conservation value, precisely because they typically are located in highly modified environments where only limited areas of original habitat remain and the species confined to them are absent from elsewhere in the landscape [5]. In forest management operations, inventories on biodiversity are used to determine the nature and distribution of biodiversity region at the region being managed [6]. Although the forest vegetations are usually covered with multi-storied tree species grown in a natural way but actually it chiefly broadcasts herbs, shrubs, trees and liana with a good number of lower groups of plants viz. mosses, lichens, ferns and fern allies [7]. In most cases the conservation of plant diversity has received considerably less attention than the conservation of animals, perhaps because plants lack the popular appeal of many animal groups [8]. Like other zoo park or managed forest, Adina Deer Park also has gained much attention for its faunal assemblage and attention to diversity of plants, especially non timber forest plants are often neglected. From the ancient time forest fringe people used forest product as the important source of livelihood, and medicines and the increasing process of resource depletion leads to pressure towards resource conservation. A lack of ecological knowledge can seriously hinder the conservation and sustainable use of economically and medicinally important plant species, especially in the face of anthropogenic threats such as overexploitation and land use change [9]. Condition is more or less similar in case of Adina Forest. Till date there is no proper taxonomic documentation of plants of Adina Forest as per our knowledge. In view of the foregoing, the present authors took up the work of documenting the age-long indigenous knowledge regarding use of plants composting the zoo forests in different adjacent parts of the forest beat. The communication is an attempt to determine the species composition and diversity of plant assemblage as well as their economic importance and status of local threats in natural and regenerated forest patches of Adina Forest.

MATERIAL AND METHODS

Study sites:

Adina Deer Park was established in year 1982 on a transferred vested land at Adina Mouza, Block Gazole under District Malda, West Bengal at 25.30°N, 88.10°E with an area of 8.90 Ha inclusive of two water bodies transferred by Addl. District Magistrate, Malda and latter many inclusions of land and water bodies enrich the Adina Deer Park. Presently it was recognized as Adina Forested Area under Adina Beat, Gazole Range, Malda Division and recommended for plantation of miscellaneous tree species. Geologically Adina Deer Park is located on the east bank of the river Mahananda in Barind region having undulating land surface of Malda district in West Bengal with an area of 80 ha and it lies at 25°30' latitude and 88°10' longitude [10]. It is situated at a distance of 22.5 km in the north direction of Malda Town. The Central Zoo Authority (CZA) granted conditional recognition of Adina Deer Park as Mini Zoo vide their letter no. 22-49/2004-CZA (489) M dt. 21.02.2007 (Annexure-I) and Adina Deer Park becomes one of the recent introductions to the Zoo Map of India under Section 38(H) of the Wildlife (Protection) Act, 1972 [4]. In addition to this the area was also recommended for plantation of miscellaneous tree species. However along with trees all types of plants including herbs, shrubs, vines etc have immense significance on the forest and wildlife. In a previous work of land use and land cover change of Adina Deer Park (ADP), the entire forest area was categorized in to four basic land cover classes namely water bodies, dense forest, sparse forest and bare land [10]. Though Adina forest is very famous for its wildlife conservation, but there is very limited information available regarding status and conservation of flora in this region. The objective of this study was to present a taxonomic documentation of plant communities of Adina Forest with their economical importance and present status in the habitat.

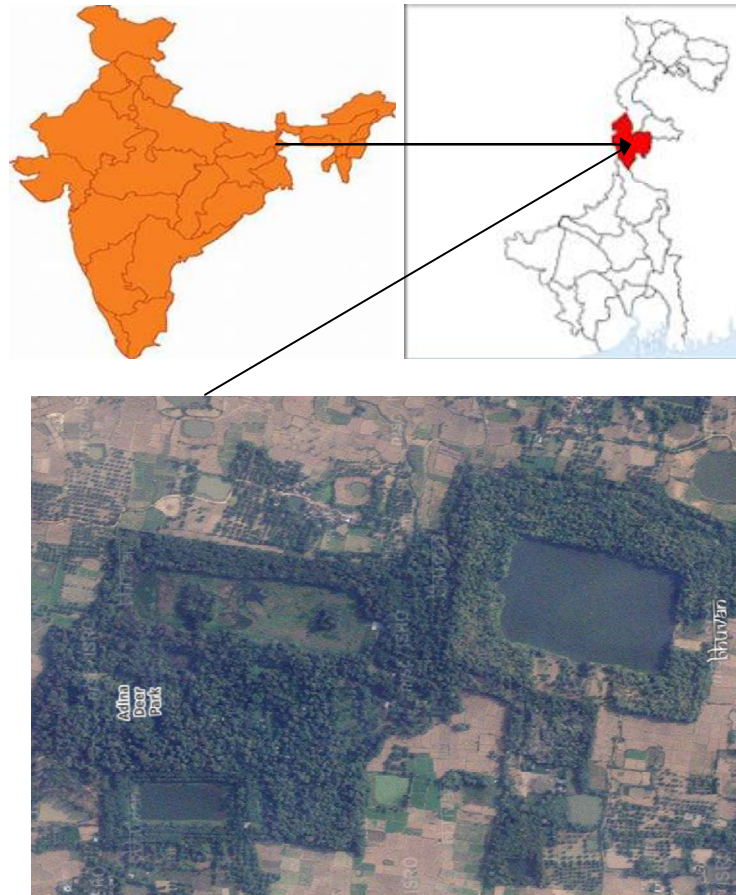


Fig 1: Location of Adina Deer Park



Fig 2: Master plan of Adina Deer Park [Adopted from reference [4] ([http://www.wbza.co.in/uploads/master plan/ Adina. Pdf](http://www.wbza.co.in/uploads/master%20plan/Adina.Pdf)) accessed 11.11.2020.]

Methodology

Frequent field trips were carried out in different forest areas under Adina Deer Park in different seasons during 2017-2020 to collect the plant specimens and ethnobotanical data. The collected plant specimens have been carefully identified with the help of different floras, books, relevant articles etc [11], [12], [13], [14], [15], [16], [17], [18]. Ethno botanical data were collected through suitable questionnaire and personal interviews. The information on vernacular names, plant parts used, local belief, and method of propagation were collected. Collected plant specimens have been preserved as herbarium specimens following the standard herbarium technique [19] and kept in the departmental Herbarium, Department of Botany, Dukhulal Nibaran Chandra College, Aurangabad (Mursidabad), West Bengal for future references.

RESULT

In the present study only vascular plants such as Angiosperms, Gymnosperms and Pteridophytes are collected, identified and documented. Arrangement of taxa is based on APG-IV 2016. A total of 178 plants from 59 families were identified from the site (Table 1). Among them 34 tree species, 10 shrub species and 134 herb species. Among the families, Leguminosae (16 species) comprises the highest number of species followed by Asteraceae (14 species), Poaceae (13 species), Lamiaceae (8 species) and the rest of the families comprise 6 or less number of species (Table 2). Based on habitat the plant species of Adina Forest is categorized in to different group (Fig 3). The study also concluded that some plants of the forested area have immense economic significance. Different parts of the plant were utilized in different purposes without disturbing the biodiversity of the forest (Fig 4). The study also found that among the species 30 species were highly frequent, 71 species were medium in occurrence, 53 species were less frequent and 24 species were rare in occurrence (Table 1).

Table: 1: Identifies Plants from different families and their Importance

SL. No.	Plant Name	Habit	Habitat	Vernacular Name	Parts Used	Economic Importance & Utilization	Frequency of Occurrence
ACANTHACEAE							
1.	<i>Thunbergia grandiflora</i> (Roxb. ex Rottl.) Roxb.	Climber	Terrestrial	Neel lata	Whole plant	Whole plant used to treat Snake bite.	Medium
2.	<i>Hemigraphis hirta</i> (Vahl.) T. Anderson	Herb	Terrestrial	-	Leaves	Used for headache, ulcer of the mouth & gums.	Less
3.	<i>Lepidagathis incurva</i> Buch.-Ham. ex D. Don	Herb	Terrestrial	-		Not known.	Medium
4.	<i>Ruellia tuberosa</i> L.	Herb	Terrestrial	Nil ghanta / Chotpoti	Root	Root paste useful to cure Stomach pain and Gastric disorder.	Medium
5.	<i>Justicia gendarussa</i> Burm.f.;	Shrub	Terrestrial	Bishalya karani	Leaves	Fresh leaves extract use as an antidote to snake venom.	High
6.	<i>Hygrophila auriculata</i> (Schumacher.) Heine	Herb	Aquatic	Kulekhara	Leaves	Fresh leaves fried or boil juice is taken for increasing haemoglobin and treatment of anaemia.	Medium
AMARANTHACEAE							
7.	<i>Alternanthera philoxeroides</i> (C. Martius) Grisebach	Herb	Aquatic	Sanchi	Tender shoot, Leaves	Use as cooked vegetable.	Medium
8.	<i>Alternanthera sessilis</i> (L.) R. Brown ex DC	Herb	Semi-Aquatic	Sanchi sak	Tender shoot, Leaves	Cooked as vegetable.	High
9.	<i>Amaranthus spinosus</i> L.	Herb	Terrestrial	Kanta-khuria	Tender shoot, Leaves	Use as cooked vegetable; also use to treat anaemia, root paste applied for stomach to treat urinary disorder.	High

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10.	<i>Aerva lanata(L.) Juss.</i>	Herb	Terrestrial	-		Not known.	Less
11.	<i>Amaranthus viridisL.</i>	Herb	Terrestrial	Note sak	Leaves, Root	Decoction of leaf is used as dysentery and inflammations and purifies the blood; Root paste useful against Indigestion.	Medium
ANACARDIACEAE							
12.	<i>Mangifera indica L.</i>	Tree	Terrestrial	Aam	Fruits, Barks, Leaves, Seeds	Eaten as raw and commonly uses in curries, chutney and pickle preparation; Bark used for the treatment of loose motion; Leaves are used during auspicious and religious occasions; Seed powder mixed with salt is used against indigestion and dysentery.	Less
APIACEAE							
13.	<i>Centella asiatica(L.) Urb.</i>	Herb	Terrestrial	Thankuni	Leaves	Use as cooked vegetable; Raw paste use as anti-diarrhoeic medicine.	Medium
APOCYNACEAE							
14.	<i>Alstonia scholaris(L.)R. Br.</i>	Tree	Terrestrial	Chatim	Leaves, Latex, Stem	Dorsal side of leaf is gently heated and massaged over the pained part; milky latex is applied during joint pain and tied with the fibres obtained from its stem.	Less
15.	<i>Tabernaemontanadivaricata (L.)R.Br. ex Roem.& Schult.</i>	Shrub	Terrestrial	Tagar	Flower	Flower paste is used for hypotension, skin diseases, aches, eye ailments and pain.	Rare
16.	<i>HolarrhenapubescensWall.e x G.Don</i>	Tree	Terrestrial	Kurchi	Leaves	Raw paste of leaves use as gastro-intestinal and anti-diarrhoeic supplement.	Rare
17.	<i>Calotropis procera (Aiton) Dryand.</i>	Shrub	Terrestrial	Akanda	Leaves, latex	Leaves are used to treat in pain relief, rheumatism and cuts; latex is used in dog bite.	Medium
ARACEAE							
18.	<i>Colocasia esculenta(L.)Schott</i>	Herb	Semi-Aquatic	kachu	Corm, Leaves with petiole	Corm, leaves and petiole are used as vegetable and different cookeries.	High

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19.	<i>Alocasia macrorrhiza</i> (L.) G. Don	Herb	Terrestrial	Mānkachu	Root stock	Cooked as vegetable; stem with ripe banana used for piles.	Medium
20.	<i>Typhonium trilobatum</i> (L.) Schott	Herb	Semi-Aquatic	Khanman/Ghet Kachu	Leaves, Petiole, Root	Cooked as vegetable; Root used to treat as an antidote to snake bite.	Rare
21.	<i>Xanthosoma sagittifolium</i> (L.) Schott	Herb	Semi-Aquatic	Dudh kachu	Leaves, Petiole	Cooked as vegetable.	Less
22.	<i>Lemna perpusilla</i> Torr.	Herb	Aquatic	Khudi pana		Not known.	Medium
23.	<i>Pistia stratiotes</i> L.	Herb	Aquatic	Topa pana		Not known.	Medium
ARALIACEAE							
24.	<i>Hydrocotyle sibthorpioides</i> Lam.	Herb	Semi-Aquatic	Bon-Thankuni	Whole plant	Decoction of whole plant is used for asthma, bone fracture, oedema, fever, detoxification, throat pain, psoriasis.	High
ARECACEAE							
25.	<i>Borassus flabellifer</i> L.	Tree	Terrestrial	Tal	Fruits, Leaves, Watery latex	Ripen fruits are used as raw and different cooking purposes; watery latex of tree trunk use as making of sugar-cake. Leaves use as hand-made fan, shading of house-roof; tree-trunk use as different household purposes.	Less
26.	<i>Phoenix sylvestris</i> (L.) Roxb.	Tree	Terrestrial	Khejur	Fruits, Leaves, Watery latex	Ripen fruits are eaten as raw; watery latex of tree trunk use as making of sugar-cake.	Less
27.	<i>Plectocomia himalayana</i> Griff.	Shrub	Terrestrial	Beth	Flexible stem	Stems are used in handicraft and furniture making.	Less
ASTERACEAE							
28.	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Herb	Terrestrial	Asamlata	Leaves	Used to treat Skin wounds and to stop bleeding.	Medium
29.	<i>Ageratum conyzoides</i> L.	Herb	Terrestrial	Bhusuripata/Ajgandha	Whole plant	Whole plant juice applied to stop bleeding; Leaf decoction is applied for skin diseases, leprosy, boils.	High
30.	<i>Enhydra fluctuans</i> Lour.	Herb	Aquatic	Helencha	Tender shoot, Leaves	Use as cooked vegetable; Leaves taken in digestion problem.	Medium
31.	<i>Elephantopus scaber</i> L.	Herb	Terrestrial	Hasti pada/Marachuta	Root	Decoction of root is useful to stop vomiting.	Medium
32.	<i>Mikania micrantha</i> Kunth.	Climber	Terrestrial	Japani Lata	Leaves	Leaf sap prevents bleeding, antiseptic, anti-inflammatory.	Medium

33.	<i>Xanthium strumarium</i> L.	Herb	Terrestrial	Cocklebur	Leaves	Decoction of the leaves is used to prevent minor external bleeding and also used as antiseptic medicine.	Medium
34.	<i>Cyanthillium cinereum</i> (L.) H. Rob.	Herb	Terrestrial	Kuksim	Whole Plant	Relief from Common cold, cough.	Medium
35.	<i>Bidens pilosa</i> L.	Herb	Terrestrial	Kantamoti	Whole plant	Used in toothache, rheumatism, leprosy, skin disease; checks bleeding. Leaf juice used in ear and eye complaint.	Medium
36.	<i>Synedrella nodiflora</i> (L.) Gaertn.	Herb	Terrestrial	-	Leaves	Leaf-sap is used for stomach-ache, rheumatism, earache and laxative.	Less
37.	<i>Eclipta prostrata</i> (L.) L.	Herb	Terrestrial	Keshuti	Leaves	Natural Hair colour and use against skin diseases.	Medium
38.	<i>Parthenium hysterophorus</i> L.	Herb	Terrestrial	Parthenium		Not known.	Less
39.	<i>Laphangium luteoalbum</i> (L.) Tzvelev.	Herb	Terrestrial	-		Not known.	Medium
40.	<i>Blumea lacera</i> (Burm.f.) DC.	Herb	Terrestrial	Kukurhuta	Whole plant	Whole plant is used to treat muscular Pain.	Medium
41.	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Herb	Terrestrial	Sachimodi	Whole plant	Plants decoction is used in bowel Complaints, night blindness and Dysentery.	Less
BORAGINACEAE							
42.	<i>Heliotropium indicum</i> L.	Herb	Terrestrial	Hatisur	Whole plant	Decoction of the whole plant is used to treat thrush, diarrhoea, diabetes, ulcers, dysentery, and bronchitis. Root sap is used in eye treatment.	Medium
CANNABACEAE							
43.	<i>Trema orientalis</i> (L.) Blume	Tree	Terrestrial	Jiban/ Khaksi daru	Root	Root decoction to reduce the Menorrhagia.	Less
CLEOMACEAE							
44.	<i>Cleome rutidosperma</i> DC.	Herb	Terrestrial	Nil hurhure	Leaves, Seeds	Decoction of leaf is used to treat malaria, appetizer, laxative applied to soothe irritable skin conditions, convulsions and earache, inflammation and deafness; Seeds used in menstrual problems.	Medium

COMBRETACEAE							
45.	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Tree	Terrestrial	Arjun	Bark of tree trunk	Bark decoction taken in empty stomach to treat cardiac trouble.	Rare
46.	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Tree	Terrestrial	Bahera	Fruits	Dried fruits use to treat against dyspepsia and Also use in serious gastritis problems.	Rare
COMMELINACEAE							
47.	<i>Commelina diffusa</i> Burm. f.	Herb	Semi-Aquatic	Kanchira	Leaves & Whole plant	Bruised plant is used against boils, dysentery.	Less
48.	<i>Commelina benghalensis</i> L.	Herb	Semi-Aquatic	Kanchira	Root, Leaves	Root paste use as an antidote to snake bite; Leaf paste is used against constipation, boils, skin diseases.	Medium
49.	<i>Murdannia nudiflora</i> (L.) Brenan	Herb	Semi-Aquatic	-	Whole plant	Plant paste is used against leprosy, headache, asthma, piles. Root used to treat jaundice.	Medium
CONVOLVULACEAE							
50.	<i>Merremia vitifolia</i> (Burm. f.) Hallier f.	Herb	Terrestrial	-	Whole plant	Juice of the whole plant is considered cooling and diuretic, high fever, strangury and urethral discharges, malaria and smallpox.	Medium
51.	<i>Ipomoea aquatica</i> Forsskal	Herb	Aquatic	Kolmi	Tender twig, Leaves, Whole plant	Cooked as vegetable; Leaf useful in snake bite, Stem in Poisonous snake bite (pain), Tender shoot in Purgative & Whole plant in spasmolytic.	Less
52.	<i>Evolvulus nummularius</i> (L.) L.	Herb	Terrestrial	Bhuikamri/ Sada Sankhapushpi	Whole plant	Decoction of whole plant is used to treat amoebic dysentery.	High
53.	<i>Cuscuta reflexa</i> Roxb.	Parasite	Epiphytic	Swarna lata	Whole plant	Whole plant juice used to treat Jaundice; ailments of diarrhoea of cow.	Rare
CUCURBITACEAE							
54.	<i>Coccinia grandis</i> (L.) Voigt	Climber	Vine	Telakucha	Leaves, Fruit	Leaf extraction used in head migraine. Decoction of leaf also applied on head to reduce the body temperature. Unripe Fruit used as	Medium

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						vegetable.	
55.	<i>Trichosanthes tricuspidata</i> Laur.	Climber	Vine	Makal fal	Young twig & Fruits	The unripe fruit and the tender shoots used as vegetable to improve appetite, digestion and anti-diabetic.	Less
56.	<i>Mukia maderaspatana</i> (L.)M.Roem.	Climber	Vine	-	Leaves, Root, Seed	Plant uses for anti-inflammatory, anorexia, astringent, anti-arthritis and acid-reflux.	Less
CYPERACEAE							
57.	<i>Kyllinga monocephala</i> Thunb.	Sedge	Terrestrial	Ghas	Whole plant	Decoction of the whole plant is used against malaria; colds with fever; whooping cough; antidote to snake venom; Use as fodder	Less
58.	<i>Cyperus rotundus</i> L.	Sedge	Terrestrial	Mutha Ghas	Root	Decoction of root is used to treat leprosy, fever, blood disease, biliousness, pain epilepsy, Ophthalmic, dyspepsia, urinary concretions, diarrhea, and stomach complaints.	High
EUPHORBIACEAE							
59.	<i>Euphorbia hirta</i> L.	Herb	Terrestrial	Dudh ghas	Leaves, Latex	Leaves used to treat menstrual problems and extract used to stop irregular periods; Latex used to treat eye problem.	High
60.	<i>Acalypha indica</i> L.	Herb	Terrestrial	Mukta Jhuri	Whole plant	Paste of whole plant used to treat as an antidote of snake venom.	Medium
61.	<i>Croton bonplandianus</i> Baill.	Herb	Terrestrial	Ban Tulsi	Leaves	Leaf extract used to treat cut and wounds.	Medium
62.	<i>Jatropha gossypifolia</i> L.	Shrub	Terrestrial	Lal bharanda	Root	Root paste used to treat tuberculosis.	Less
63.	<i>Ricinus communis</i> L.	Shrub	Terrestrial	Rerhi	Seed	Seed oil used as pain killer.	Less
64.	<i>Mallotus nudiflorus</i> (L.) Kulju & Welzen	Tree	Terrestrial	Pithali	Root	Roots applied in gout and rheumatism. Pounded bark is given in snakebite.	Rare
HYDROCHARITACEAE							
65.	<i>Ottelia alismoides</i> (L.) Pers.	Herb	Aquatic	Panikola	Seeds	Eaten as raw.	Less
LAMIACEAE							
66.	<i>Clerodendrum infortunatum</i> L.	Shrub	Terrestrial	Bhant Phool	Leaves, Flower	Fresh young leaf paste soup is	High

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						given in empty stomach for treatment of intestinal worm; Flower used in ritual festivals.	
67.	<i>Leucas aspera</i> (Willd.) Link	Herb	Terrestrial	Danda kalas	Leaves, Flower nectar	Used in jaundice, oedema, asthma, wormicide, nasal drops in sinusitis, cold and jaundice, flower nectar used in cough and cold.	Medium
68.	<i>Anisomeles indica</i> (L.) Kuntze	Herb	Terrestrial	Gopali / Apang	Leaves & Root	Carminative, astringent, uterine infection and Decoction of the plant for dysentery, inflammation, boil, fever, cough. Root is anti-allergic, cures sores and ulcers of the mouth.	Less
69.	<i>Leonurus sibiricus</i> L.	Herb	Terrestrial	Raktadron		Not known.	Less
70.	<i>Ocimum americanum</i> L.	Herb	Terrestrial	Ban Tulsi	Leaves	Decoction of leaves used to stop bleeding, to coetaneous disease, gastric disorder of children, hepatic affections. It is also used to treat common cold and cough. Juice applied on affected area in case of insects' bites, and used to treat nasal problems.	Less
71.	<i>Hyptis suaveolens</i> (L.) Poit.	Herb	Terrestrial	Bilati Tulsi	Root and Leaves	Decoction of the roots is valued as an appetizer, rheumatism. Leaves are used stomach problems, fevers, cold.	Rare
72.	<i>Tectona grandis</i> L.f.	Tree	Terrestrial	Teak	Wood, Bark, Seed, Flower	Woods used as expectorant, anti inflammatory, anti helminthic. Bark as stringent, used in bronchitis. The oil is obtained from seeds and flower is useful for treatment of scabies, eczema and ringworm. Flower used in bronchitis and urinary discharges.	Rare
73.	<i>Gmelina arborea</i> Roxb.	Tree	Terrestrial	Gamari	Root	Root extract is used in stomach disorder; Inner	Rare

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						portion of fresh root paste use as an antidote to snake bite.	
LEGUMINOSAE							
74.	<i>Crotalaria pallida</i> Aiton	Herb	Terrestrial	Jangli motor	Leaves, Flower	Leaves and floral parts of the plants are sometimes used in paralysed part.	Less
75.	<i>Desmodium trifolium</i> (L.)DC.	Herb	Terrestrial	Amtua	Root	Root paste is used to cure the Dysuria and Haematuria.	High
76.	<i>Senna tora</i> (L.) Roxb.	Herb	Terrestrial	Chekenda	Tender shoot, Leaves	Leaves are applied for skin diseases such as leprosy, ringworm, itching and psoriasis and snakebites.	High
77.	<i>Senna sophora</i> (L.) Roxb.	Herb	Terrestrial	Kalkasunda	Young leaves, Root	Cook in curry; Paste prepared from root along with black pepper is given to treat jaundice and paste prepared from leaf mixed with sugar candy is taken one or two tea spoonful twice-thrice daily to treat dyasuria.	Less
78.	<i>Mimosa pudica</i> L.	Herb	Terrestrial	Lajwabati	Leaves, Root & seeds	Toothache, leprosy, dysentery, vaginal and uterine complaints, inflammation, leucoderma, fatigue, asthma, blood diseases, jaundice, leprosy, ulcers, small pox.	Medium
79.	<i>Mimosa invisa</i> Colla.	Herb	Terrestrial	-	Leaves, Root	Leaves are applied against snake bites and having antioxidant and antibacterial.	Less
80.	<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	Tree	Terrestrial	Minjiri		Not known.	Rare
81.	<i>Dalbergia sissoo</i> DC.	Tree	Terrestrial	Sisoo	Leaves	Leaf juice used to treat stomach disorder; diabetes.	Rare
82.	<i>Acacia nilotica</i> subsp. <i>Indica</i> (Benth.) Brenan	Tree	Terrestrial	Babool	Latex, Leaves, Tender twig	Latex used to treat dysentery, indigestion, acidity. Young leaves for physical weakness. Tender twig use to treat as various dental problems.	Less

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83.	<i>Leucaena leucocephala</i> (Lam.) de Wit	Tree	Terrestrial	Subabul	Seeds	Seeds are used to control stomachache, as contraception and abortifacient and anti-diabetic.	Rare
84.	<i>Cassia fistula</i> L.	Tree	Terrestrial	Bador lathi	Leaves, Fruit, Flower, Root	The leaf extract and fruit pulp are used as laxative. Flowers and pods used as febrifugal, astringent and purgative. Root pastes are used for skin disease and tuberculosis glands. Seed powder used in amoebiasis.	Rare
85.	<i>Peltophorum pterocarpum</i> (DC.) K. Heyne	Tree	Terrestrial	Radhachura	Bark of stem	The stem bark is useful in dysentery.	Rare
86.	<i>Caesalpinia pulcherima</i> (L.) Sw.	Tree	Terrestrial	Krishnachura	Root, Bark	Root decoction used in intermittent fevers, bark is abortifacient.	Rare
87.	<i>Acacia auriculiformis</i> Benth.	Tree	Terrestrial	Akashmoni		Not known.	Medium
88.	<i>Butea monosperma</i> (Lam.) Taub.	Tree	Terrestrial	Palash	Flower, tender leaves	Flowers are used in ritual purpose and making natural color; tender leaves are useful against Diabetes.	Less
89.	<i>Desmodium gangeticum</i> (L.) DC.	Herb	Vine	Sinar	Root	Root paste used by tribal people for reducing pain.	Less
LENTIBULARIACEAE							
90.	<i>Utricularia scandens</i> Benj.	Herb	Aquatic	Patangabhuk		Not known.	Less
91.	<i>Utricularia aurea</i> Lour.	Herb	Aquatic	Patangabhuk		Not known.	Less
LINDERNIACEAE							
92.	<i>Lindernia ciliate</i> (Colsm.) Pennell	Herb	Terrestrial	-		Not known.	Rare
93.	<i>Lindernia crustacea</i> (L.) F. Muell	Herb	Terrestrial	-		Not known.	Medium
94.	<i>Lindernia ruellioides</i> (Colsm.) Pennell	Herb	Semi-Aquatic	-		Not known.	Less
LYTHRACEAE							
95.	<i>Lagerstroemia speciosa</i> (L.) Pers.	Tree	Terrestrial	Jarul	Leaves	Decoction of leaves extracts useful against diuretic and purgative action.	Less
MALVACEAE							
96.	<i>Sida rhomboidea</i> Roxb.	Herb	Terrestrial	Svetbarela	Leaves	Leaves useful against blood vomiting.	Medium
97.	<i>Sida cordata</i> (Burm.f.) Borss. Waalk.	Herb	Terrestrial	Barela	Leaves, Root	Decoction of root and leaves paste useful against blood vomiting.	Less
98.	<i>Urena lobata</i> L.	Herb	Terrestrial	Bon Okara	Root, Leaves	Root extraction used to treat hydrophobia. Fresh leaf juice applied to treat bone fracture.	Medium
99.	<i>Abutilon indicum</i> (L.) Sweet	Herb	Terrestrial	Potari		Not known.	Less
100.	<i>Triumfetta rhomboidea</i> Jacq.	Herb	Terrestrial	Bon Okara	Root &	Decoction of the	Medium

.					Leaves	root is used for internal ulcerations; Leaves are antihypertensive, astringent, diuretic and used for diarrhoea, dysentery, internal haemorrhages and gonorrhoea.	
101	<i>Bombax ceiba</i> L.	Tree	Terrestrial	Shimul	Root, Latex, Leaves	Root is used in bone fracture and blood dysentery. Latex is used in amoebiasis.	Rare
MELIACEAE							
102	<i>Azadirachta indica</i> A.Juss.	Tree	Terrestrial	Neem	Leaves, tender shoot	Leaf sap is used to treat fever and acidity; leaf paste is used for skin diseases; tender shoot useful against tooth-ache.	Rare
103	<i>Melia azedarach</i> L.	Tree	Terrestrial	Ghora-neem	Leaves, Seeds	Leaves control many pests; seeds are useful as expectorant, anthelmintic, skin diseases.	Less
104	<i>Swietenia macrophylla</i> King	Tree	Terrestrial	Mehogany	Leaves, Branches, Seed	Dried leaves and branches are used as fuel wood for forest adjacent local people, Seed pulp decoction used for control blood sugar level.	Rare
MENISPERMACEAE							
105	<i>Stephania japonica</i> (Thunb.) Miers	Climber	Vine	Akundi/ Nimukha	Root, Leaves	Roots used to treat bowel complaints, pain in the stomach, dyspepsia, diarrhoea, dropsy, cough, and prolepses of uteri. Leaves used to bilious fever, birth control, and leucorrhoea. Roots and leaves used for piles, dysentery and cough.	Medium
MENYANTHACEAE							
106	<i>Nymphoides indica</i> (L.) Kuntze	Herb	Aquatic	-		Not known.	Less
MOLLUGINACEAE							
107	<i>Glinus oppositifolius</i> (L.) Aug. DC.	Herb	Terrestrial	Gima sak	Leaves	Leaves cooked as vegetable.	Medium
MORACEAE							
108	<i>Artocarpus heterophyllus</i> Lam.	Tree	Terrestrial	Kanthal	Fruit, seed	Unripe used as vegetable and ripe fruits are used as raw; fruit also acts as a	Less

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						tonic for the liver and skin ailment stimulant, anti dotes of snake venom.	
109	<i>Ficus racemosa</i> L.	Tree	Terrestrial	Jug-Dumur	Fruit, Stem	Fried fruit eaten for reducing blood pressure; stem wood useful in the Hindu ritual programmes.	Rare
110	<i>Ficus hispida</i> L.f.	Tree	Terrestrial	Dumur	Fruits	Fried fruit reduce blood sugar level.	Medium
MYRTACEAE							
111	<i>Eucalyptus globulus</i> Labill.	Tree	Terrestrial	Eucalyptus	Leaves	Decoction of leaves is used for various skin diseases.	Medium
112	<i>Syzygium cumini</i> (L.) Skeels	Tree	Terrestrial	Jam	Ripe fruit	Eaten raw; fruit juice is used for anti-diabetic, blood purification, liver tonic.	Less
NYCTAGINACEAE							
113	<i>Boerhavia repens</i> L.	Herb	Terrestrial	Punarnaba	Root	Fresh root is used to cure Asthma and withdrawal of alcohol or smoking.	Medium
NYMPHAEACEAE							
114	<i>Nymphaea pubescens</i> Willd.	Herb	Aquatic	Dhaap	Petioles & seeds	Petioles cooked as vegetable; fried seed taken as dry food.	Medium
ONAGRACEAE							
115	<i>Ludwigia adscendens</i> (L.) H.Hara	Herb	Aquatic	Keshardam	Whole plant	Decoction of whole plant is used in Skin disease, Ulcer.	Medium
116	<i>Ludwigia perennis</i> L.	Herb	Semi-Aquatic	Bon lavango	Whole plant	Boiled plant extract used externally to reduce fever.	Less
OXALIDACEAE							
117	<i>Oxalis corniculata</i> L.	Herb	Terrestrial	Amrulpata	Whole Plant	Dysentery, diarrhoea, piles, asthma, skin disease; refrigerant, appetizer.	High
PAPAVERACEAE							
118	<i>Argemone mexicana</i> L.	Herb	Terrestrial	Siyal kanta	Tender shoot	In curry.	Medium
PHYLLANTHACEAE							
119	<i>Phyllanthus reticulatus</i> Poir.	Herb	Terrestrial	BhuiAmla	Whole plant	Decoction of whole plant is applied for diarrhea, dysentery, dyspepsia, colic, jaundice and liver problems.	Medium
120	<i>Phyllanthus fraternus</i> G.L. Webster	Herb	Terrestrial	BhuiAmla	Whole plant	Whole plant is used as antipyretic, antiseptic, astringent, diuretic, dropsy,	Medium

						diarrhea, dysentery, dyspepsia, colic, gonorrhea, menorrhagia, genitor-urinal problems, jaundice and bronchitis as well as in asthma. Decoction used to treat jaundice and liver problems.	
121	<i>Bischofia javanica</i> Blume	Tree	Terrestrial	Kanjai		Not known.	Rare
122	<i>Phyllanthus emblica</i> L.	Tree	Terrestrial	Amlaki	Fruits	Unripe fruits are used as anti-diabetic, various stomach disorder problems, dysentery and blood purifying medicine.	Less
PIPERACEAE							
123	<i>Peperomia pellucida</i> (L.) Kunth	Herb	Semi-Aquatic	Luchipata	Whole plant	Whole plant paste used against boils.	Medium
PLANTAGINACEAE							
124	<i>Mecardon procumbens</i> (Mill.)Small	Herb	Terrestrial	Garurbrahmi	Whole Plant	The plant is brain stimulant as well as neuro-stimulant; applied for several other diseases like Skin problems, cold, fever, cough, headache, diarrhoea, fertility problems, toothache, stomach ache, wounds, diabetes, rheumatism, asthma, dysentery, small pox, bone fractures, earache, hair loss and snake bite.	Medium
125	<i>Scoparia dulcis</i> L.	Herb	Terrestrial	Chinipata	Leaves, Root, Seed	Leaf is used against boils and tumours as well as pneumonia, anti-diabetic, bladder stone, kidney complaints, toothache, mouth ulcers, and diabetes. Roots used in diarrhoea, dysentery, menorrhagia. Seed powder taken to treat kidney problems.	Medium

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126	<i>Lindenbergia indica</i> Vathe.	Herb	Terrestrial	Haldi Basanto		Not known.	Medium
POACEAE							
127	<i>Axonopus compressus</i> (Sw.) P. Beauv.	Herb	Terrestrial	Ghas	Whole plant	Decoction of the whole plant is used to treat diabetes, heart problems and skin diseases. It has antimicrobial and anti-oxidant properties also.	High
128	<i>Cynodon dactylon</i> (L.) Pers.	Herb	Semi-Aquatic	Durbaghas	Whole plant	Decoction of the whole plant is used to treat leucoderma, inflammation, leprosy, ant dysenteric, antipyretic, astringent, diuretic, laxative, styptic dysentery, cough and urogenital disorder.	High
129	<i>Digitaria sanguinalis</i> (L.) Scop.	Herb	Terrestrial	Ghas	Whole plant	Use as fodder.	Medium
130	<i>Coix lachryma-jobi</i> L.	Herb	Terrestrial	Gurguri	Tender shoot & Leaves	Use as fodder.	Rare
131	<i>Oplismenus burmanni</i> (Retz.) P. Beauv.	Herb	Terrestrial	Ghas	Leaves	Decoction of leaf is used in eye treatments; use as fodder.	High
132	<i>Imperata cylindrica</i> (L.) Raeusch.	Herb	Terrestrial	Ghas	Whole plant	Use as fodder.	Medium
133	<i>Saccharum spontaneum</i> L.	Herb	Terrestrial	Kash	Leaves	Dried leaves are used for hut's roof making.	Medium
134	<i>Eleusine indica</i> (L.) Gaertn.	Herb	Terrestrial	Ghas	Root	Use as antidote of snake venom; use as fodder.	High
135	<i>Eragrostis amabilis</i> (L.) Wight & Arn.	Herb	Terrestrial	Sursuri ghas	Whole plant	Use as fodder.	Medium
136	<i>Sacciolepis indica</i> (L.) Chase	Herb	Terrestrial	Ghas	Whole plant	Use as fodder.	Less
137	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Herb	Terrestrial	Ghas	Whole plant	Use as fodder.	Less
138	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Herb	Terrestrial	Chorkata Ghas	Whole plant	Use as fodder.	High
139	<i>Dendrocalamus strictus</i> (Roxb.) Nees	Tree Grass	Terrestrial	Bamboo	Tender shoots, Mature stem, Root	Young shoot is used as Cooked as curry; Mature stem used to prepare fencing; Root paste used for anti dote of dog bite.	Less
POLYGONACEAE							
140	<i>Persicaria hydroiper</i> (L.) Delarbre	Herb	Aquatic	Packur mul	Whole plant	Effective cure for toothache, epilepsy, gangrene, rheumatism, and gout.	Medium
141	<i>Rumex maritimus</i> L.	Herb	Terrestrial	Ban palang	Leaves	Decoction of leaves used in long term complaints of gastrointestinal tract.	Medium
PONTEDERIACEAE							

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142	<i>Monochoria hastata</i> (L.) Solms.	Herb	Aquatic	Nukha	Leaves	Used as tonic, cooling agent for Curing boils.	Less
143	<i>Eichhornia crassipes</i> (Mart.) Solms.	Herb	Aquatic	Kachuri Pana		Not known.	High
PORTULACACEAE							
144	<i>Portulaca oleracea</i> L.	Herb	Terrestrial	Nuniasak	Tender Shoot	Cooked as vegetable.	Medium
RHAMNACEAE							
145	<i>Ziziphus jujuba</i> Mill.	Shrub	Terrestrial	Kul	Fruit	Eaten raw; in making pickles.	Medium
RUBIACEAE							
146	<i>Dentella repens</i> (L.) J.R.Forst. & G.Forst.	Herb	Terrestrial	-		Not known.	High
147	<i>Oldenlandia corymbosa</i> L.	Herb	Terrestrial	-		Not known.	High
148	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Tree	Terrestrial	Kadam	Inflorescence	Cooked as vegetable; House furnishing and decorative purpose.	Less
RUTACEAE							
149	<i>Glycosmis pentaphylla</i> DC.	Herb	Terrestrial	Ashshewra	Root	Root powder is used to treat fever, hepatopathy, eczema, skin diseases, wounds, liver disorder.	High
150	<i>Limonia acidissima</i> Groff	Tree	Terrestrial	Kodbel	Fruit	Eaten raw; helpful against dyspepsia, stomach disorder.	Less
151	<i>Murraya koenigii</i> (L.) Spreng.	Shrub	Terrestrial	Karipata	Leaves	Use as condiment, leaves juice eaten raw for cure of dysentery, diarrhea, checking vomiting, hereditary diabetes, skin disease, fever.	Less
SALICACEAE							
152	<i>Flacourtia indica</i> (Burm.f.) Merr.	Tree	Terrestrial	Boichi	Root	Decoction of root bark given to cure Cholera.	Rare
SOLANACEAE							
153	<i>Physalis minima</i> L.	Herb	Terrestrial	Bantipariya	Whole plant	Relief from Colic, ulcers, cough, bronchitis.	Medium
154	<i>Nicotiana plumbaginifolia</i> Viv.	Herb	Terrestrial	Jangli Tamak		Not known.	High
155	<i>Solanum torvum</i> Sw.	Herb	Terrestrial	Bish Bagoon	Root, Fruit, Leaves	Root decoction is venereal diseases, boil. Fruit is diuretic and is used for malaria, stomach aches. Leaves are an effective antimicrobial and diuretic, anti-diabetic.	Less
156	<i>Solanum sisymbriifolium</i> Lam.	Herb	Terrestrial	Swetrangani		Not known.	High
157	<i>Solanum nigrum</i> L.	Herb	Terrestrial	Kakmachi	Leaves	Cooked as vegetable.	High

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158	<i>Solanum viarum</i> Dunal	Herb	Terrestrial	Kantabegun	Fruit	Fruit extract used in toothache.	Medium
URTICACEAE							
159	<i>Pouzolzia zeylenica</i> (L.) Benn.	Herb	Terrestrial	-	Root	Roots eaten to cure dysentery, cough and Asthma.	High
160	<i>Pilea microphylla</i> (L.) Liebm.	Herb	Terrestrial / Epiphytic	-		Not known.	Medium
VERBENACEAE							
161	<i>Phyla nodiflora</i> (L.) Greene	Herb	Terrestrial	-		Not known.	Medium
162	<i>Lantana camara</i> L.	Shrub	Terrestrial	Ban-tulsi/ Gandga-Chotra	Leaves, Bark, Flower	Leaves are applied for headaches, fever, flu, coughs, colds toothaches and indigestion boils, swellings and pain of the body. Bark is used for leprosy and ulcer. Flower for tuberculosis.	Medium
VITACEAE							
163	<i>Cissus quadrangularis</i> L.	Herb	Vine	Harjora	Stem	Stem extract is used to treat broken Bone.	Medium
164	<i>Ampelocissus latifolia</i> (Roxb.) Planch.	Herb	Vine	Gowalia-lata	Whole plant	Plants are used in fever, cough-cold tonic.	Less
FERN							
ATHYRIACEAE							
165	<i>Diplazium esculentum</i> (Retz.) Sw.	Herb	Sciophyte	Dheki shak	Tender shoot, Leaves	Cooked as vegetable.	High
DRYOPTERIDACEAE							
166	<i>Dryopteris filix-mas</i> (L.) Schott.	Herb	Sciophyte	-	Fronds	Cooked as vegetable.	Less
LYGODIACEAE							
167	<i>Lygodium flexuosum</i> (L.) Sw.	Herb	Terrestrial	Bhutraj		Not known.	Less
POLYPODIACEAE							
168	<i>Drynaria quercifolia</i> (L.) J. Sm.	Herb	Epiphytic	Pankhiraj	Pinnae, Rhizome	Pinnae is used in treatment of bone fracture; rhizome paste applied externally for blood clotting.	Medium
169	<i>Microsorium punctatum</i> (L.) Copel.	Herb	Epiphytic	Fish tail	Fronds	Paste useful against Constipation, urinary disorders, snakebite, dysentery and for healing wounds.	Medium
170	<i>Pyrrosia lanceolata</i> (L.) Farw.	Herb	Epiphytic	-	Fronds	Paste useful against Cough & cold and sore throats.	High
PTERIDACEAE							
171	<i>Ceratopteris thalictroides</i> (L.) Brongn.	Herb	Aquatic	Jol Agacha		Not known.	Medium
172	<i>Pteris vittata</i> L.	Herb	Terrestrial / Lithophyte	-	Whole plant	A paste prepared from the whole plant is applied to the affected area for the	High

						treatment of fractures and also taken for coughs in children.	
173	<i>Adiantum caudatum</i> L.	Herb	Sciophyte	Goyali Lata	Rhizome	Rhizome paste used against Whooping cough and fever.	Medium
174	<i>Adiantum lunulatum</i> Burm. f.	Herb	Sciophyte	Biddapata	Young frond	Frond paste useful against asthma, leprosy; also use as hair tonic.	Medium
THE LYPTERIDACEAE							
175	<i>Christella dentate</i> (Forssk.) Brownsey & Jermy	Herb	Sciophyte	Bisdhenkia	Fronds	Swellings, rheumatism, blood vomiting, urinary disorders, insect repellent, wounds & cuts.	Medium
SALVINIACEAE							
176	<i>Azolla pinnata</i> R. Br.	Herb	Aquatic	-	Whole plant	Use to increase the fertility of rice field, Use as fodder.	Medium
177	<i>Salvinia natans</i> (L.) All.	Herb	Aquatic	-		Not known.	Less
MARSILEACEAE							
178	<i>Marsilea minuta</i> L.	Herb	Aquatic	Shushni	Fronds	Cooked as vegetable.	High

Table 2: Families along with no. of plant species in ADP.

Sl. No.	FAMILY	No. of Species
1	Acanthaceae	06
2	Amaranthaceae	05
3	Anacardiaceae	01
4	Apiaceae	01
5	Apocynaceae	04
6	Araceae	06
7	Araliaceae	01
8	Arecaceae	03
9	Asteraceae	14
10	Boraginaceae	01
11	Cannabaceae	01
12	Cleomaceae	01
13	Combretaceae	02
14	Commelinaceae	03
15	Convolvulaceae	04
16	Cucurbitaceae	03
17	Cyperaceae	02
18	Euphorbiaceae	06
19	Hydrocharitaceae	01
20	Lamiaceae	08
21	Leguminosae	16
22	Lentibulariaceae	02
23	Linderniaceae	03
24	Lythraceae	01
25	Malvaceae	06
26	Meliaceae	03
27	Menispermaceae	01
28	Menyanthaceae	01
29	Molluginaceae	01
30	Moraceae	03
31	Myrtaceae	02

32	Nyctaginaceae	01
33	Nymphaeaceae	01
34	Onagraceae	02
35	Oxalidaceae	01
36	Papaveraceae	01
37	Phyllanthaceae	04
38	Piperaceae	01
39	Plantaginaceae	03
40	Poaceae	13
41	Polygonaceae	02
42	Pontederiaceae	02
43	Portulacaceae	01
44	Rhamnaceae	01
45	Rubiaceae	03
46	Rutaceae	03
47	Salicaceae	01
48	Solanaceae	06
49	Urticaceae	02
50	Verbenaceae	02
51	Vitaceae	02
52	Athyriaceae	01
53	Dryopteridaceae	01
54	Lygodiaceae	01
55	Polypodiaceae	03
56	Pteridaceae	04
57	Thelypteridaceae	01
58	Salviniaceae	02
59	Marsileaceae	01

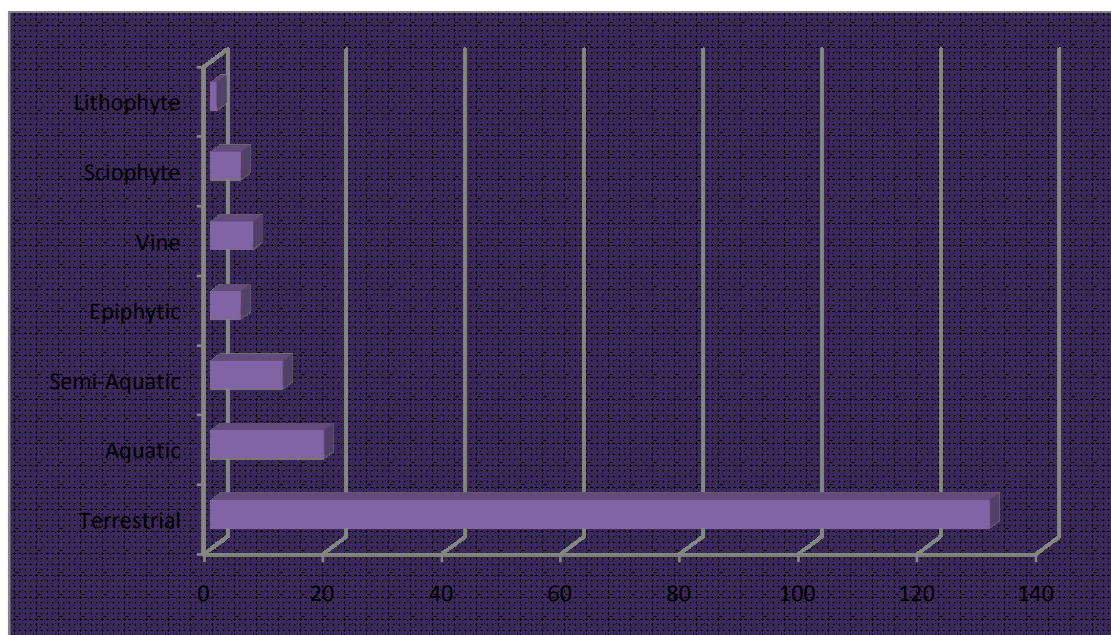


Fig 3: Graphical Representation of status of plant assemblages of ADP based on habitat

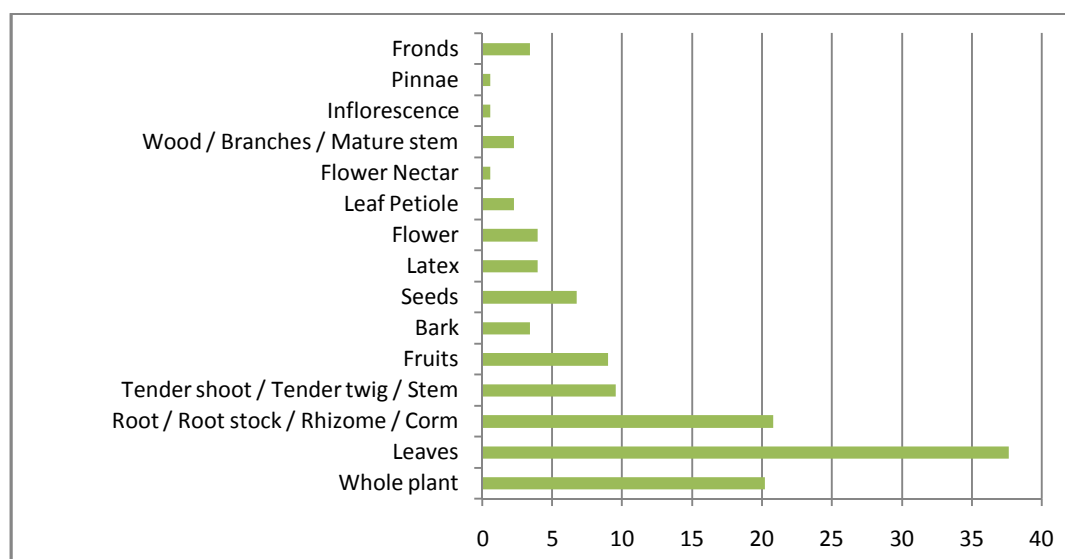


Fig 4: Graphical Representation of status of useful plant assemblages of ADP based plant part used

DISCUSSION

Adina Deer Park has become one of the most popular travel destinations and entertainment sites for local people of Malda district and adjacent districts of West Bengal, Bihar and Jharkhand. This protected area is suitable for ecotourism, public education, ex-situ conservation, excursions and scientific research. Beautiful scenery and diversity of animal species in their living collections have been helping this deer park attract visitors from several parts of Indian subcontinent. In this study it was found that it shares a huge collection of plants in its limited landscape. Now a day's most of the protected areas especially ecoparks are facing rapid destruction of natural habitats, thus threatening the survival of several indigenous species of plants and animals. A huge number of plants are in danger of extinction and many of the rare, endangered and insufficiently known plants with indigenous species are no more seen in their original habitat. However in a study it was concluded that some parts of the park called dense forest and water bodies increased from 15.68 to 39.64 ha and 8.12 to 9.17 ha; where as other parts namely sparse forest and bare land declined from 31.02 to 22.08 ha and 22.59 to 9.11 ha respectively [10]. In many parts of the world ecotourism makes a model to conserve nature and natural resources. It is estimated that possibly half or more of all current species could be at risk of extinction in the foreseeable future [20], [21]. From ecological aspect, assessment of biodiversity of any habitat or locality has been regarded as one of the vital issue for careful preservation, promotion and management of the variety of life forms [22]. The detail knowledge of species-specific food choice i.e., fodder and the distribution pattern of food resources i.e., availability of fodder over the habitat are the two fundamental prerequisites to improve the habitat quality and have a great value for in situ conservation of any species [23]. People living in the forest fringe villages depend upon forest for a variety of goods and services viz., edible fruits, flowers, tubers, roots and leaves for food and medicines; firewood for cooking (some also sale in the market); materials for agricultural implements, house construction and fencing; fodder (grass and leave) for livestock and grazing of livestock in forest; and collection of a range of marketable non-timber forest products [24].

Most forests are intensively managed and to a large extent they have been transformed into high yielding non-specific plantations with a decreased species richness and structural diversity [25]. The interaction between newly introduced plant and native plants might influence the vegetation succession. The appropriate management of forest resources is also linked to many aspects of forest conservation, e.g. practical, economic or, seen very broadly, environmental issues [1]. In this protected area among the plant species much attention has gained by timber plants but very little or no attention is given to non timber plants. Many rural people and visitor knowingly or unknowingly damage different herbs, shrubs, vines, ferns etc. Some herbs were collected as fodder for the faunal communities of the forest and also collected by the local people for domestic cattles. *Cynodon dactylon* (L.) Pers., *Digitaria sanguinalis* (Linn.) Scop., *Coix lachryma-jobi* Linn., *Oplismenus burmanni* (Retz.) P.Beauv., *Imperata cylindrica* (L.) Raeusch., *Saccharum spontaneum* L., *Eleusine indica* (L.) Gaertn., *Eragrostis amabilis* (L.) Wight & Arn., *Sacciolepis indica* (L.) Chase, *Dactyloctenium aegyptium* (L.) Willd., *Chrysopogon aciculatus* (Retz.) Trin. etc were widely used as fodder and some of them *Coix lachryma-jobi* Linn., *Sacciolepis indica* (L.) Chase, *Dactyloctenium aegyptium* (L.) Willd., *Imperata cylindrica* (L.) Raeusch., *Saccharum spontaneum* L. were found

less in number in the region. Some herbs were also used for edible and medicinal purposes and unscientifically collected by local people and visitor viz. *Hygrophila auriculata* (Schumach.) Heine,

Centella asiatica(L.) Urb., *Eclipta prostrate* (L.) L., *Ocimum americanum* L., *Glinus oppositifolius*(L.) Aug. DC., *Nymphaea pubescens* Willd., *Glycosmis pentaphylla* DC.etc. Some plants were also damaged due to so called de-weeding practices *Amaranthus spinosus*; *Amaranthus viridis* Linn., *Colocasia esculenta* (L.)Schott., *Alocasia macrorrhiza*(L.) G. Don., *Typhonium trilobatum*(L.) Schott, *Xanthosoma sagittifolium*(L.) Schott., *Alternanthera sessilis*(C.Martius) Grisebach, *Enhydra fluctuans* Lour., *Ipomoea aquatic* Forsskal, *Diplazium esculentum*(Retz.) Sw.,*Marsilea minuta*L.etc. The rich plant collections in this ecopark can provide visual illustrations of the diversity of the plant kingdom and the beauty of plant diversity. Adina Deer Park might be the only places in Malda where people can touch nature and can learn about plants and animals. It is no doubt that all animals are directly or indirectly dependent on plant diversity as increased plant species diversity has been linked to improvements in ecosystem function, including increased primary (plant) productivity, greater stability in response to disturbance, improved nutrient cycling, and greater resistance to weed invasion [26], [27].



PLATE- I: A: Front Gate of Adina Deer Park Reserve Forest; B: Map of the Forest; C-D: Old Heritage Lake present within the Forest; E-F: Different sites of Forest; G: Deer (*Axis axis*); H: Nilgai (*Boselaphus tragocamelus*)

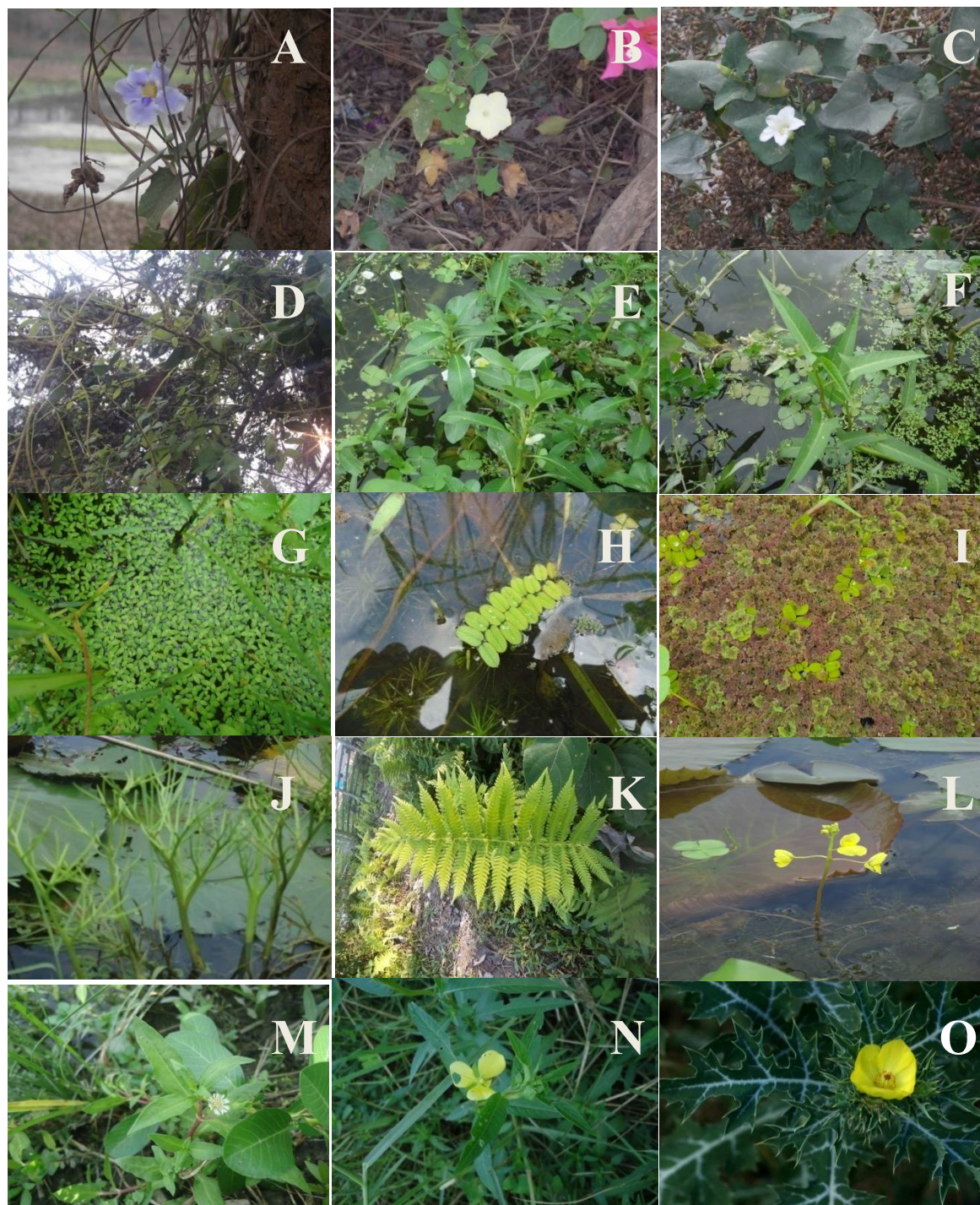


PLATE- II: A: *Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.; B: *Merremia vitifolia* (Burm. F.) Hallier f.; C: *Coccinia grandis* (L.) Voigt; D: *Cuscuta reflexa* Roxb.; E: *Ludwigia adscendens* (L.) H.Hara; F: *Ipomoea aquatica* Forsskål; G: *Lemna perpusilla* Torr; H: *Salvinia natans* (L.) All.; I: *Azolla pinnata* R. Br.; J: *Ceratopteris thalictroides* (L.) Brongn.; K: *Christella dentate* (Forssk.) Brownsey & Jermy; L: *Utricularia scandens* Benj.; M: *Eclipta prostrata* (L.) L.; N: *Ludwigia perennis* L.; O: *Argemone mexicana* L.



PLATE- III: A: *Dendrocalamus strictus* (Roxb.) Nees.; B: *Solanum viarum* Dunal.; C: *Hygrophila auriculata* (Schumach.) Heine; D: *Clerodendrum infortunatum* L.; E: *Leucas aspera* (Willd.) Link.; F: *Commelina diffusa* Burm. f.; G: *Glycosmis pentaphylla* DC.; H: *Nymphoides indica* (L.) Kuntze; I: *Oxalis corniculata* L.; J: *Pyrrosia lanceolata* (L.) Farw.; K: *Microsorium punctatum* (L.) Copel.; L: *Diplazium esculentum* (Retz.) Sw.; M: *Drynaria quercifolia* (L.) J. Sm.; N: *Colocasia esculenta* (L.) Schott.; O: *Eichhornia crassipes* (Mart.) Solms.

CONCLUSION

The present investigation provides first hand comprehensive information on the floristic diversity of angiosperms of the Adina Deer Park (ADP). According to the study number of species is quite good in terms of the geographic area of the ADP. This conclusion is supported by the existence of 59 families and 178 species in the limited surface area of the area. Different life forms of plants also observed in the area. Investigation on the plants species indicated that the total flora was composed mostly of angiosperms. Within a limited area it provides varied topography constituting varied type of microhabitats supporting different life forms which extent of angiosperm diversity. Most of the plants encountered in the study were herbs. The floristic structure provides food, fodder, livelihood along with shelter for the fauna.

According to the respondents some plants are widely used as rural medicines. Although the area is protected, but is experiencing destruction because of the frequent visits of people from nearby area, collection of bioresources by villages for their daily requirements (fuel, medicine, fodder, bamboo and other non-timber forest produce) and over grazing by livestock. Abundance of some plant species were damaged due to excessive grazing of animals. Scientific harvesting, storage and handling of NTFPs need to be introduced and enhanced at grass root level since these perspectives can play a potential role in imparting sustainability to the system in operation. However the area is committed towards protection and preservation of species and strives for a peaceful co-existence of development and conservation. The strategy of this kind work for awareness education among the ethnic people bound with the forest patches towards role of plants and wildlife in the environment conservation. Appropriate conservation measures such as stabilizing population growth to minimize the escalating demand for fodder, proving alternative livelihood and energy sources to people living in close proximity to forests, and promoting plantations may restore the flora and fauna of the forest and may balance ecological service. With the involvement of botanists and botanical institutes for implementation of systematic and scientific conservation as well as research work on plants in Adina Deer Park may also upgrade the area just like a Botanical Garden. The present study in the Adina Deer Park is preliminary, and subsequent re census will be helpful for the restoration and management of forested regions in the larger-scale conservation planning of the area and adjacent ranges.

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CONFLICT OF INTEREST

There is no conflict of interest.

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